Chapter 1

Family Communication Letter (English) 2

Family Communication Letter (Spanish) 3

Section 1.1 4

Section 1.2 9

Section 1.3 14

Section 1.4 19

Section 1.5 24

Cumulative Review 29

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Name _____ Date _____

Chapter 1 Solving Linear Equations

Dear Family,

Solving equations is an important skill in the math classroom, but how about in everyday life? Have you ever considered how you may use this skill in real life?

Consider the following scenario:

- You and your family want to purchase a new video game system. The system costs $400. You already have $250 saved to put toward the system. How much money do you still need to save to buy the system?

You could simply subtract $250 from $400 to get your answer. Consider writing an equation instead. What would that look like? The unknown, in this case, the amount of money left to save, can be represented by a *variable*. One example of an equation is $y + 250 = 400$, where y is the unknown value.

Discuss how you would find the unknown value.

Now, as a family, brainstorm ways you could earn the money. Will you earn the money working together? Or will you divide the remaining amount needed to be earned among the members of your family and work independently?

Next, write an equation for each scenario. How are the equations the same? How are they different? Is the value of the variable the same for both scenarios?

As your child works through Chapter 1, he or she will learn how to solve similar types of equations. Share together other ways you as family use equations in everyday life, maybe without even realizing it.

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Nombre _____ Fecha _____

Capítulo 1

Resolver ecuaciones lineales

Estimada familia:

Resolver ecuaciones es una destreza importante en la clase de matemáticas, pero ¿qué pasa en la vida cotidiana? ¿Alguna vez han considerado cómo pueden usar esta destreza en la vida real?

Consideren la siguiente situación:

- Usted y su familia quieren comprar un nuevo sistema de videojuegos. El sistema cuesta $400. Ya han ahorrado $250 para el sistema. ¿Cuánto dinero aún necesitan ahorrar para comprar el sistema?

Podrían simplemente restar $250 de $400 para obtener la respuesta. En cambio, consideren escribir una ecuación. ¿Cómo sería? En este caso, la incógnita, la cantidad de dinero que falta ahorrar, puede representarse con una *variable*. Un ejemplo de la ecuación sería $y + 250 = 400$, donde y es el valor desconocido. Comenten cómo hallarían el valor desconocido.

Ahora, en familia, propongan maneras en que podrían ganar el dinero. ¿Ganarán el dinero trabajando juntos? ¿O dividirán la cantidad restante que deben ahorrar entre los integrantes de su familia y trabajarán por separado?

Luego, escriban una ecuación para cada situación. ¿En qué se parecen las ecuaciones? ¿En qué se diferencian? ¿El valor de la variable es igual para ambas situaciones?

A medida que su hijo avanza en el capítulo 1, aprenderá cómo resolver tipos de ecuaciones semejantes. Compartan otras maneras en que su familia usa ecuaciones en la vida cotidiana, quizás sin ni siquiera darse cuenta.

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1.1 Start Thinking

The angle measures of any four-sided figure sum to 360 degrees. How can you find the fourth angle measure when you know the sum of the other three angle measures?

1.1 Warm Up

Simplify the expression.

1. $5 + (-15)$

2. $6 - 7$

3. $10 \bullet (-1)$

4. $\frac{-30}{2}$

5. -1×0

6. $4 - (-5)$

1.1 Cumulative Review Warm Up

Tell which property the statement illustrates.

1. $2 + 4 = 4 + 2$

2. $(3 \bullet 7)4 = 3(7 \bullet 4)$

3. $8 + 0 = 8$

4. $7 \bullet \left(\frac{1}{7}\right) = 1$

5. $4 \bullet 0 = 0$

6. $12(8 + 3) = 12 \bullet 8 + 12 \bullet 3$

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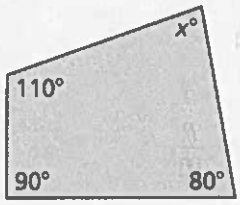
1.1 Practice A

In Exercises 1–6, solve the equation. Justify each step. Check your solution.

1. $x + 2 = 5$
2. $g - 4 = 3$
3. $m - 1 = 8$
4. $d + 4 = -2$
5. $p + 7 = 5$
6. $k - 6 = -4$

The sum of the angle measures of a quadrilateral is 360°. In Exercises 7 and 8, write and solve an equation to find the value of x. Use a protractor to check the reasonableness of your answer.

7.



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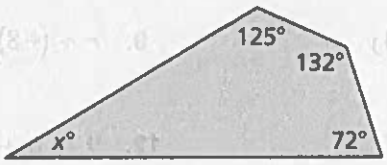

In Exercises 9–14, solve the equation. Justify each step. Check your solutions.

9. $3t = 24$
10. $7p = 28$
11. $s + 4 = 3$
12. $j + 5 = 2$
13. $-6q = 54$
14. $c + (-9) = 2$

In Exercises 15–20, solve the equation. Check your solution.

15. $h + \frac{1}{3} = \frac{5}{3}$
16. $w - \frac{7}{9} = \frac{2}{9}$
17. $\frac{3}{5}f = 9$
18. $u + 2.7 = 1.5$
19. $32\pi t = 64\pi$
20. $m + (-7) = 2.1$

In Exercises 21–23, write and solve an equation to answer the question.

21. The width of a laptop is 11.25 inches. The width is 0.75 times the length. What is the length of the laptop?
22. The temperature at 10 A.M. is 12 degrees Fahrenheit. The temperature at 6:00 A.M. was −7 degrees Fahrenheit. How many degrees did the temperature rise?
23. The population of a city is 645 people less than it was 5 years ago. The current population is 13,500. What was the population 5 years ago?
24. Identify the property of equality that makes Equation 1 and Equation 2 equivalent.

Equation 1	$4.2x - 1.5 = 1.7x + 8.3$
Equation 2	$42x - 15 = 17x + 83$

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1.1 Practice B

In Exercises 1–6, solve the equation. Justify each step. Check your solution.

1. $p + 7 = -9$
2. $0 = k - 2$
3. $-10 = w + 1$
4. $g + (-3) = 4$
5. $-14 = -9 + q$
6. $s - (-12) = 15$
7. Shopping online, you find a skateboard that costs \$124.99, which is \$42.50 less than the price at a local store. Write and solve an equation to find the local price.

In Exercises 8–13, solve the equation. Justify each step. Check your solutions.

8. $-32 = 4y$
9. $r \div (-8) = 5$
10. $\frac{k}{3} = 4$
11. $\frac{z}{-2} = 7$
12. $9 = b \div (-1)$
13. $-100 = \frac{p}{10}$

In Exercises 14–19, solve the equation. Check your solution.

14. $k - \frac{4}{7} = \frac{2}{7}$
15. $-\frac{2}{9}d = 18$
16. $h + \frac{\pi}{2} = \frac{3\pi}{2}$
17. $5t = -7.5$
18. $4 + 12 \div 2 = -5v$
19. $a + 8 = 9 \times 3 - 10$
20. Describe and correct the error in solving the equation.

$$-\frac{2}{3}p = 4$$
$$-\frac{2}{3}p + \frac{2}{3} = 4 + \frac{2}{3}$$
$$p = 4\frac{2}{3}$$

21. As c decreases, does the value of x *increase*, *decrease*, or *stay the same* for each equation? Assume c is positive.

Equation	Value of x
$x + c = 0$	
$-cx = -c$	
$\frac{x}{c} = 1$	

22. One-fifth of the plants in a garden are grape tomato plants. Two-ninths of the plants in the garden are cherry tomato plants. The garden has 18 grape tomato plants and 20 cherry tomato plants. How many other plants are in the garden? Explain.

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1.1 Enrichment and Extension

Solving Simple Equations

Solve the equation. Justify each step. Check your solution.

1. $x + \frac{4}{5} = \frac{5}{2}$

2. $\frac{9}{16} = \frac{3}{4}t$

3. $w - \frac{1}{2} = 2\frac{2}{3}$

4. $\frac{m}{-7} = 1\frac{1}{4}$

5. $\frac{\pi}{2}t = \frac{5\pi}{6}$

6. $x + \frac{4}{5} = -\frac{7}{8}$

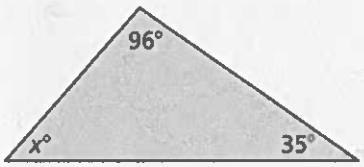
7. $3.2t = 6.4$

8. $150 = 7.5x$

9. $w + 2.4 = 6.52$

The sum of the angle measures of a polygon follows the general rule of $(n - 2) \cdot 180°$, where the variable n represents the number of sides. In Exercises 10–15, write and solve an equation to find the value of x. Use a protractor to check the reasonableness of your answer.

10.



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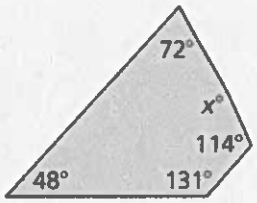

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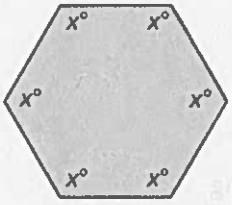

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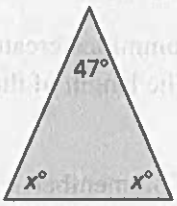

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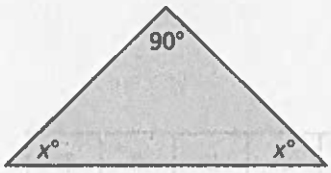

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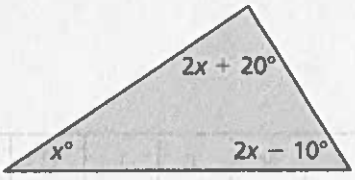

16. It takes a plane 4 hours and 15 minutes to fly from Orlando, Florida, to Boston, Massachusetts. The distance between the two cities is 1114 miles.

a. What is the average speed of the plane in miles per hour?

b. If every mile is approximately 1.6 kilometers, what is the speed of the airplane in kilometers per hour?

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1.1 Puzzle Time

Did You Hear About The Tree's Birthday?

Circle the letter of each correct answer in the boxes below. The circled letters will spell out the answer to the riddle.

Find the value of the variable which satisfies the equation.

1. $m + 7 = 9$

2. $x + 11 = 4$

3. $n - \frac{3}{5} = \frac{2}{5}$

4. $-18 = r - 12$

5. $s - (-10) = 2$

6. $6.3 = b - 1.5$

7. $1.4h = 5.6$

8. $y \div 9 = -3$

9. $-7c = -63$

10. $\frac{x}{8} = -3$

11. $-\frac{6}{7}a = 18$

12. $-144\pi = -12\pi k$

Solve an equation to answer the question.

13. The students on a decorating committee create a banner. The length of the banner is 2.5 times its width. The length of the banner is 20 feet. What is the width (in feet) of the banner?

14. The student council consists of 32 members. There are 27 members decorating for the dance. How many members are not decorating?

B	L	I	B	M	T	T	C	N	W	D	A	O	E	S	P
15	−18	4	2.1	13	−16	−21	4.6	17	9	−13	5	9.1	8.2	7.8	11.6
A	Q	G	U	S	A	H	P	R	I	P	Y	O	J	N	E
−8	20	−17	16	2	−24	14	1	18	−14	−27	−7	8	−20	12	−6

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1.2 Start Thinking

In 2007, the average American high school student spent 6.8 hours on homework per week. Suppose you kept track of the amount of time you spent on homework from last Monday through last Thursday. How can you use an equation to find the amount of time you need to spend on Friday to equal the national average in 2007?

1.2 Warm Up

Simplify the expression.

1. $(2x^2 - 6x) - (-2x^2 + 3x)$
2. $(5a^2 - a) - (2a^2 - 5a)$
3. $(4y^2 + y) - (6y^2 - 5y)$
4. $(-2d^2 - d) - (5d^2 - 5d)$
5. $(2h^2 + 5z) + (2h^2 + 9z)$
6. $(2y^2 + 9xy) + (3y^2 - 2xy)$

1.2 Cumulative Review Warm Up

Determine whether the given number is a solution to the equation.

1. $6x + 1 = 7x - 1; x = 2$
2. $5 - 4x = 2x^2 + x; x = 3$
3. $2y - \frac{2}{3} = 2; y = \frac{4}{3}$
4. $\frac{4u}{3} = -8; u = -6$

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1.2 Practice A

In Exercises 1–6, solve the equation. Check your solution.

1. $5t + 2 = 12$

2. $14 = 9 - p$

3. $\frac{h}{2} + 7 = 10$

4. $\frac{k - 4}{3} = 3$

5. $35 = 2b + 5b$

6. $9f + 4 - 7f = 8$

7. The cost c (in dollars) of renting a paddle board for h hours is given by $c = 25 + 7h$. After how many hours is the cost \$81?

In Exercises 8–10, solve the equation. Check your solution.

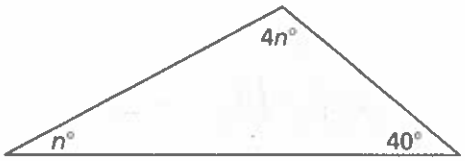
8. $-3(2r + 7) = 3$

9. $4 + 6(7 - m) = 4$

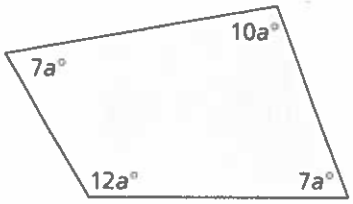
10. $19 = 15w - 4(3w - 1)$

In Exercises 11 and 12, find the value of the variable. Then find the angle measures of the polygon. Use a protractor to check the reasonableness of your answer.

11. Sum of angle measures: 180°



12. Sum of angle measures: 360°



In Exercises 13–16, write and solve an equation to find the number.

13. The sum of 4 and three times a number is 19.

14. The difference of twice a number and 7 is 9.

15. Ten less the quotient of a number and 3 is 6.

16. Five times the sum of a number and 4 is −15.

In Exercises 17 and 18, write and solve an equation to answer the question. Check that the units on each side of the equation balance.

17. You purchase two bottles of sunscreen and a hat. The hat costs \$6.50. You pay 6% sales tax. You pay a total of \$16.43. How much does one bottle of sunscreen cost?

18. The perimeter of a patio is 64 feet. The width of the patio is 12 feet and the length of the patio is $(x + 6)$ feet. What is the length of the patio?

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1.2 Practice B

In Exercises 1–6, solve the equation. Check your solution.

1. $8 = \frac{t}{-3} + 4$
2. $\frac{p + 5}{-2} = 9$
3. $3k + 2k = 60$
4. $-43 = 12 - 6p + p$
5. $28 = 8b + 13b - 35$
6. $-11j - 6 + 3j = -30$
7. A bill to landscape your yard is \$720. The materials cost \$375 and the labor is \$34.50 per hour. Write and solve an equation to find the number of hours of labor spent landscaping your yard.

In Exercises 8–11, solve the equation. Check your solution.

8. $12 - 5(3r + 2) = 17$
9. $3(x - 2) + 5(2 - x) = 16$
10. $3 = -1(v - 4) + 4(2v - 9)$
11. $6(q - 7) - 3(4 - q) = 0$

In Exercises 12–14, write and solve an equation to find the number.

12. Seven plus the quotient of a number and 5 is -12.
13. The difference of three times a number and half the number is 60.
14. Eight times the difference of a number and 3 is 40.
15. Justify each step of the solution.

$7 - 2(x - 10) = 15$	Write the equation.
$7 - 2(x) - 2(-10) = 15$	
$7 - 2x + 20 = 15$	
$-2x + 27 = 15$	
$-2x = -12$	
$x = 6$	

16. An odd integer can be represented by the expression $n + 2$, where n is any odd integer. Find three consecutive odd integers that have a sum of -51.

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1.2 Enrichment and Extension

Consecutive Integers

In algebra, there are many problems that involve working with consecutive integers. To solve this type of problem, you must first know how to represent these numbers algebraically.

Example: Find three consecutive odd integers with a sum of 57.

A common way to represent any odd integer is to write the number as $2n + 1$, where n is any integer. Notice the expression $2n$ always results in an even integer. So, when you add 1, the integer is odd. If $2n + 1$ is the first odd integer, then add 2 to get to the next consecutive odd integer, $2n + 3$, and so on.

$(2n + 1) + (2n + 3) + (2n + 5) = 57$

Write and solve an equation for the consecutive integer problem.

1. Find four consecutive even integers with a sum of -52.
2. Find two consecutive integers with a sum of 29.
3. Find four consecutive odd integers with a sum of 200.
4. If the lesser of two consecutive even integers is five more than half the greater, what are the two integers?
5. If the sum of the first two consecutive even integers is equal to three times the third, what are the three integers?
6. Find four consecutive integers such that three times the sum of the first two integers exceeds the sum of the last two by 70.
7. Find a set of five consecutive integers such that the greatest integer is three times the least.

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1.2 Puzzle Time

Why Did The Muffler Quit The Car Business?

Write the letter of each answer in the box containing the exercise number.

Find the value of the variable which satisfies the equation.

1. $4a - 5 = 11$
2. $16 = 17 - t$
3. $8 = \frac{k}{-3} - 2$
4. $\frac{b + 7}{4} = 9$
5. $12c + 6c = 36$
6. $14x + 11x + 10 = 85$
7. $19w - 13 - 6w = -39$
8. $-4(2n - 5) = -28$
9. $8s + 3(12 - 7s) = 49$
10. $-18 = 15z - 9(2z - 2)$

Solve an equation to find the number.

11. The difference of six times a number and 7 is -49.
12. Negative sixteen plus the quotient of a number and -4 is -3.
13. The sum of two times a number and 11 is -7.
14. The total cost for a week at camp is \$220. You have \$140. You earn \$16 for every item you sell in a fundraiser. How many items do you need to sell to pay for a week at camp?

Answers

E. -7
T. 1
I. 6
E. 2
X. 5
D. -1
S. -30
A. 29
H. -2
W. 12
T. -52
A. 3
S. 4
U. -9

8	2		10	4	1		11	14	7	6	13	3	12	5	9

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1.3 Start Thinking

One common use of an equation with variables on both sides involves situations in which two distances are the same, but the rates of travel are different (for example, the speed of a car). List three separate real-life examples where this concept could be applied.

1.3 Warm Up

Use the Distributive Property to simplify the expression.

1. $5(u - 5)$
2. $17(2 + n)$
3. $-5(e - 4)$
4. $-3(t + 7)$
5. $4(v - 6)$
6. $4(a + 5)$

1.3 Cumulative Review Warm Up

Simplify the expression.

1. $-1 + (-1) + (-1)$
2. $(10)(-10)(-10)(10)$
3. $-6 - (-6)$
4. $\frac{300}{-3} \div \frac{300}{3}$
5. $4 + 4 - 4 + 4 - 4 + 4$
6. $2(10 - 2)(2 - 8)(6 - 2)(2 - 4)(2 - 2)$

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1.3 Practice A

In Exercises 1–8, solve the equation. Check your solution.

1. $4x - 7 = -3x$
2. $8b + 2 = 3b + 12$
3. $7k + 24 = -16 - 3k$
4. $-5t + 7 = 11t - 25$
5. $6n + 1 = 2n - 7$
6. $8h + 5 - 3h = 8h - 4$
7. $g - 10 + 7g = 15 + 3g$
8. $-3(w + 4) = 4w - 5$
9. In the equation $35t + 70(7 - t) = 385$, the variable t represents the number of hours you drove at 35 miles per hour on a 385-mile trip. How many hours did you drive at 35 miles per hour?

In Exercises 10–13, solve the equation, if possible. Determine whether the equation has *one solution, no solution,* or *infinitely many solutions.*

10. $7y + 13 = 5y - 3$
11. $8 + 9p = 9p - 7$
12. $3(7r - 2) = 21r - 6$
13. $2(3x + 6) = 3(2x - 6)$
14. Describe and correct the error in solving the equation.

$$\begin{aligned} 2(s - 5) &= 2(s + 5) \\ 2s - 10 &= 2s - 10 \\ 2s &= 2s \\ 0 &= 0 \end{aligned}$$

The equation has infinitely many solutions.

15. One serving of oatmeal provides 16% of the dietary fiber you need daily. You must get the remaining 21 grams of dietary fiber from other sources.
    a. How many grams of dietary fiber do you need daily?
    b. Fifty percent of the dietary fiber in one serving of oatmeal is soluble fiber. How many grams of soluble fiber are in one serving of oatmeal?

In Exercises 16 and 17, find the value of r.

16. $5(x - 4) + 4 + r = 4(x + 3) + x$
17. $3(2x - 2) - r + 3x = 2(7x + 1) - 5x - 9$

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1.3 Practice B

In Exercises 1–8, solve the equation. Check your solution.

1. $5t + 7 = 3t - 9$
2. $-8u + 3 = 2u - 17$
3. $6w + 3 - 10w = 7w - 8$
4. $-a + 4a - 9 = 8a + 6$
5. $9(k - 2) = 3(k + 4)$
6. $-2(x - 4) = 7(x - 4)$
7. $\frac{2}{3}(3 - 6x) = -3(8x - 4)$
8. $8(3g + 2) - 3g = 3(5g - 4) - 2$

In Exercises 9–12, solve the equation, if possible. Determine whether the equation has *one solution*, *no solution*, or *infinitely many solutions*.

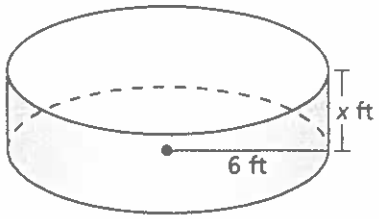
9. $5(2f + 3) = 2(5f - 1)$
10. $\frac{1}{3}(12 - 24v) = -2(4v - 2)$
11. $3(k + 1) + 11k = 2(4 + 5k) + 3$
12. $-4(-m + 2) + 2m = -\frac{1}{2}(10 - 12m) - 3$

13. Using the information in the table, write and solve an equation to find the number of toppings when you would pay the same amount for Pizza A and Pizza B.

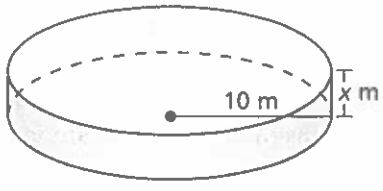
	Cheese pizza	Price per topping
Pizza A	\$10	\$1.50
Pizza B	\$12.50	\$1.00

In Exercises 14 and 15, the value of the surface area of the cylinder is equal to the value of the volume of the cylinder. Find the value of x. Then find the surface area and volume of the cylinder.

14.



15.



16. Four times the greater of two consecutive integers is 18 more than three times the lesser integer. What are the integers?

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1.3 Enrichment and Extension

Identities and No-Solution Equations

An *identity* is an equation that is true for every value of the variable. When you solve an identity equation, your result will be a true statement. On the other hand, if an equation results in an untrue statement, there is no possible solution.

Example:

Solve $5x - (3x + 7) = 9 + 2(x - 8)$.

$$5x - (3x + 7) = 9 + 2(x - 8)$$
$$5x - 3x - 7 = 9 + 2x - 16$$
$$2x - 7 = 2x - 7$$

Example:

Solve $x - (5x + 2) = -4(x - 3)$.

$$x - (5x + 2) = -4(x - 3)$$
$$x - 5x - 2 = -4x + 12$$
$$-4x - 2 = -4x + 12$$
$$-2 \neq 12$$

In Exercises 1–4, determine whether the equation is an identity or no-solution equation. If the equation is neither, find the solution.

1. $-5(2 - 3x) = 3(1 - 5x) + 1$
2. $4(5p + 7) - 4p = 6(5 + 3p) - 2(p + 1)$
3. $2(7w - 1) + 5w = w + 3(4w + 3) + 2(3w - 9)$
4. $9 - (9 - y) - 9 = 9(9 + y) - 9$
5. Use the true statement $5x - 3 = 5x - 3$ to write your own identity.
6. Use the false statement $5 \neq 7$ to write your own no-solution equation.
7. Create an equation with a solution of $x = 5$.

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1.3 Puzzle Time

What Is The Best Way To Communicate With A Fish?

Write the letter of each answer in the box containing the exercise number.

Find the value of the variable which satisfies the equation.

1. $14 - 3x = 4x$
2. $6a - 10 = 3a + 17$
3. $9 + 5w - 14w = 12 - 6w$
4. $12(b + 2) = 8(b + 5)$
5. $6(y + 8) = 3(2y - 7)$
6. $\frac{3}{4}(12c - 4) = 15c + 15$
7. $11(4p + 4) - 4p = 4(7p - 7)$
8. $3(2d - 8) = 11d - 18(d - 3)$
9. $5(4 + r) = \frac{1}{2}(40 + 10r)$
10. $\frac{3}{5}e - 6 = -\frac{2}{5}(e - 10) - 7$
11. Three consecutive integers are n, $n + 1$, and $n + 2$. Four times the sum of the least and greatest integers is 12 less than three times the least integer. What is the least integer?

Answers

P. 4

L. 3

E. 9

I. 6

N. no solution

A. 2

D. infinitely many solutions

T. −6

R. −4

I. −1

O. −3

9	11	6	4		3	7		1		10	8	5	2

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1.4 Start Thinking

Absolute value is the measurement of the distance from zero on a number line. Use a ruler to construct a number line from -4 to 4 with equal amounts of space between the tick marks. Use your construction to compare the distance from 0 to 4 and from 0 to -4. Explain how this proves the absolute value of -4 and 4 are both equal to 4.

1.4 Warm Up

Determine whether the situation could involve negative numbers. Explain your reasoning.

1. the number of points one team scores in a basketball game
2. the amount of money in a bank account
3. the amount of electricity used on this month's bill compared to last month's bill

1.4 Cumulative Review Warm Up

Copy and complete the statement using <, >, or =.

1. $|-82|$ ___?___ $|57|$
2. $|-67|$ ___?___ $|-70|$
3. $|-70|$ ___?___ $|-91|$
4. $|-27|$ ___?___ $|42|$
5. $|22|$ ___?___ $|-19|$
6. $|-61|$ ___?___ $|61|$

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1.4 Practice A

In Exercises 1–4, simplify the expression.

1. $-|-2|$
2. $|-7|-|7|$
3. $|-3 \cdot 2|$
4. $\left|\frac{-15}{5}\right|$

In Exercises 5–12, solve the equation. Graph the solution(s), if possible.

5. $|r| = 5$
6. $|q| = -7$
7. $|b - 2| = 5$
8. $|k + 6| = 9$
9. $|-5p| = 35$
10. $\left|\frac{a}{3}\right| = 4$
11. $|8y - 3| = 13$
12. $|x + 4| + 7 = 3$
13. The minimum distance between two fence posts is 4 feet. The maximum distance is 10 feet.
    a. Represent these two distances on a number line.
    b. Write an absolute value equation that represents the minimum and maximum distances.

In Exercises 14–19, solve the equation. Check your solutions.

14. $|j| = |2j + 3|$
15. $|3f - 6| = |9f|$
16. $|b + 3| = |2b - 2|$
17. $|4h - 2| = 2|h + 3|$
18. $3|w - 5| = |2w + 10|$
19. $|2y + 5| = 3y$
20. Your friend says the absolute value equation $|2x + 9| + 7 = 3$ has two solutions because the constant on the right side of the equation is positive. Is your friend correct? Explain.
21. Describe a real-life situation that can be modeled by an absolute-value equation with the solutions $x = 5$ and $x = 10$.

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1.4 Practice B

In Exercises 1–10, solve the equation. Graph the solution(s), if possible.

1. $|p - 3| = 10$
2. $|-2k| = 6$
3. $|6f| = -2$
4. $\left|\frac{q}{5}\right| = 3$
5. $|-a + 2| + 9 = 6$
6. $3|4 - 3m| = 30$
7. $-4|5g - 12| = -12$
8. $|x - 3| + 9 = 30$
9. $3|2d - 6| + 2 = 2$
10. $7|2c - 6| + 4 = 32$

11. A company manufactures penny number 2 nails that are 1 inch in length. The actual length is allowed to vary by up to $\frac{1}{32}$ inch.

    a. Write and solve an absolute value equation to find the minimum and maximum acceptable nail length.

    b. A penny number 2 nail is 1.05 inches long. Is the nail acceptable? Explain.

In Exercises 12–14, write an absolute value equation that has the given solutions.

12. 3 and 9
13. −5 and 15
14. 4 and 11

In Exercises 15–20, solve the equation. Check your solutions.

15. $|9w - 4| = |2w + 10|$
16. $2|n + 7| = |4n + 8|$
17. $3|3t + 1| = 2|6t + 3|$
18. $|5r + 3| = 2r$
19. $|j - 5| = |j + 9|$
20. $|2k + 4| = |2k + 3|$

21. You conduct a random survey of your small town about having a townwide garage sale. Of those surveyed, 56% are in favor and 44% are opposed. The actual percent could be 5% more or 5% less than the acquired results.

    a. Write and solve an absolute value equation to find the least and greatest percents of your town population that could be opposed to a townwide garage sale.

    b. A friend claims that half the town is actually opposed to a townwide garage sale. Does this statement conflict with the survey data? Explain.

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1.4 Enrichment and Extension

Extraneous Solutions in Algebra

In many algebraic problems, there is the possibility of finding an apparent solution to a problem that does not solve the equation correctly. These solutions are called *extraneous solutions*. When solving absolute value equations, you see extraneous solutions for the first time, and they continue to come up as you continue through algebra. Solving square root equations is another time when you may find extraneous solutions. Recall that you cannot have a negative value under the radical, and when you take the square root of a number, the answer is never negative.

Example: Solve $\sqrt{12 - x} = x$.

$\sqrt{12 - x} = x$	Write the equation.
$\left(\sqrt{12 - x}\right)^2 = x^2$	Square each side.
$12 - x = x^2$	Simplify.
$x^2 + x - 12 = 0$	Write in standard form.
$(x + 4)(x - 3) = 0$	Factor.
$x + 4 = 0$	Set each factor equal to zero and solve.
$x = -4$	
$x - 3 = 0$	
$x = 3$	

Check:

$\sqrt{12 - (-4)} \stackrel{?}{=} (-4)$

$\sqrt{16} \stackrel{?}{=} -4$

$4 \neq -4$

$\sqrt{12 - (3)} \stackrel{?}{=} 3$

$\sqrt{9} \stackrel{?}{=} 3$

$3 = 3$

The apparent solution, $x = -4$ is extraneous. So, the only solution of the equation is $x = 3$.

Solve the equation. Check your answer for extraneous solutions.

1. $|x - 2| = 3x - 4$

2. $\dfrac{x + 3}{x + 2} = 1 - \dfrac{x + 1}{x + 2}$

3. $m = \sqrt{56 - m}$

4. $\dfrac{k + 8}{k} - \dfrac{k - 4}{k} = 3$

5. $|3 + x| = 3x + 5$

6. $\sqrt{90 - n} = n$

7. $\dfrac{y - 3}{y - 1} + \dfrac{2y}{y - 1} = 2$

8. $|-3x| = x$

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Name_____ Date_____

1.4 Puzzle Time

Did You Hear About The Two Ducks In A Race?

A	B	C	D	E	F
G	H	I	J	K	L
M	N				

Complete each exercise. Find the answer in the answer column. Write the word under the answer in the box containing the exercise letter.

5, 9 FEET	0 IN
−7, 7 THRILL	$\frac{1}{2}$, 10 SEVERAL
4 THE	7 IT
−3, 3 AND	−2, 2 WINNER
3 OF	$-2, \frac{2}{5}$ AGONY
−14, 7 FAST	no solution OF
17 RESULTED	−1 WEBBED
$-\frac{1}{2}, \frac{1}{4}$ TIE	−7, 15 VICTORY
−11, 6 THE	−11 SECOND

Simplify the expression.

A. $|-7|$

B. $|-17|$

C. $|16| - |-16|$

D. $\left|-\frac{36}{9}\right|$

Find the value of the variable which satisfies the equation. Check your solution.

E. $|x| = 7$

F. $|b| = -19$

G. $|w - 4| = 11$

H. $|-8e| = 24$

I. $|2q + 5| = 17$

J. $6|5p + 4| - 16 = 20$

K. $|c - 24| = 7c$

L. $|3s - 11| = |s + 9|$

M. $|h - 8| = |h + 10|$

N. During last year's volleyball season, the coach concluded that the number of points scored in each game could be given by the equation $|x - 7| = 2$. How many points were scored in each game?

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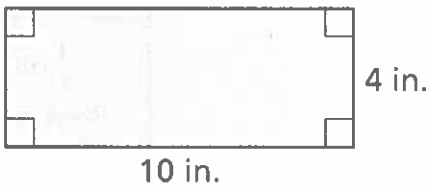
1.5 Start Thinking

Sometimes equations have more than one unknown variable. In these types of equations, it is still possible to solve the equation for one of the variables. When solving equations with more than one unknown variable, how can you decide which operations to use to isolate one of the variables?

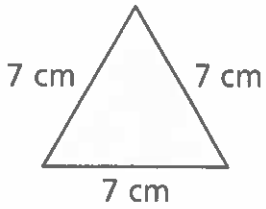
1.5 Warm Up

Use the information to find the measurement.

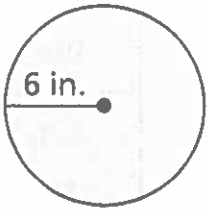
1. Find the area.



2. Find the perimeter.



3. Find the circumference. Use 3.14 for π.



1.5 Cumulative Review Warm Up

Solve the equation.

1. $y - 4 = 9$

2. $p + 5 = -6$

3. $6h = 18$

4. $\frac{x}{-2} = 5$

5. $4 - u = 2$

6. $-y = 2.3$

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Name_____ Date_____

1.5 Practice A

In Exercises 1–6, solve the literal equation for y.

1. $4x + y = 7$
2. $y - 5x = 9$
3. $3y - 15x = 12$
4. $8x + 2y = 18$
5. $7x - y = 35$
6. $4x + 1 = 9 + 4y$

In Exercises 7–12, solve the literal equation for x.

7. $y = 5x - 2x$
8. $r = x + 9x$
9. $b = 3x + 9xy$
10. $w = 2hx - 11x$
11. $p = 4x + qx - 5$
12. $m = 9 + 3x - dx$

13. The total cost C (in dollars) to participate in a triathlon series is given by the literal equation $C = 90x + 35$, where x is the number of triathlons in which you participate.

    a. Solve the equation for x.

    b. In how many triathlons do you participate if you spend a total of \$305? \$665?

    c. If your maximum annual triathlon cost is \$1000, what is the maximum number of triathlons in which you could participate?

In Exercises 14–16, solve the formula for the indicated variable.

14. Force: $f = ma$; Solve for m.
15. Volume of a cylinder: $V = \pi r^2 h$; Solve for h.
16. Perimeter of a triangle: $P = a + b + c$; Solve for b.
17. You deposit \$1500 in an account that earns simple interest at an annual rate of 3%.

    a. How long must you leave the money in the account to earn \$900 in interest?

    b. The total amount (principle plus interest) in an account earning simple interest after t years is given by the formula $A = p + prt$. How much is in the account after 5 years?

    c. Solve the equation in part (b) for p.

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1.5 Practice B

In Exercises 1–6, solve the literal equation for y.

1. $3y - 9x = 24$
2. $10 - 2y = 46$
3. $3x + 5 = 9 - 4y$
4. $-5x + 7y = 8x + 7$
5. $3 + \frac{1}{5}y = 2x + 4$
6. $10 - \frac{1}{3}y = 4 + 6x$

In Exercises 7–14, solve the literal equation for x.

7. $g = 4x + 5xy$
8. $w = 4ax - 9x$
9. $z = 6x + px + 2$
10. $t = 10 + 7x - qx$
11. $ax - bx = k$
12. $p = qx + rx + s$
13. $11 - 4x - 3jx = w$
14. $x - 8 + 3vx = y$

15. Describe and correct the error in solving the equation for x.

$$k = ax + bx + d$$
$$k = x(a + b + d)$$
$$x = \frac{k}{a + b + d}$$

In Exercises 16–18, solve the equation for the indicated variable.

16. Simple interest: $I = prt$; Solve for r.
17. Volume of a box: $V = \ell wh$; Solve for w.
18. Heron's formula: $2S = a + b + c$; Solve for b.
19. Coulomb's Law is given by the formula

$$F = k\frac{q_1 q_2}{d^2}.$$

The force F between two charges q_1 and q_2 in a vacuum is proportional to the product of the charges, and is inversely proportional to the square of the distance d between the two charges. Solve the formula for k.

20. You deposit \$800 in an account that earns simple interest at an annual rate of 5%. How long must you leave the money in the account to earn \$100 in interest?

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1.5 Enrichment and Extension

Draining a Bathtub

Evangelista Torricelli was an Italian mathematician and physicist. He is best known for his invention of the barometer, but he is also well known for his law regarding the speed of fluid flowing out of an opening. For a bathtub with a rectangular base, *Torricelli's Law* implies that the current height h of the water in the tub t seconds after it begins draining is given by the equation

$$h = \left[\sqrt{h_0} - \frac{2\pi d^2\sqrt{3}}{\ell w}t\right]^2$$

where ℓ and w are the tub's length and width, d is the diameter of the drain, and h_0 is the water's initial height. (All measurements are in inches.)

Suppose you fill a tub completely with water. The tub is 60 inches long by 30 inches wide by 25 inches high, and has a drain with a 2-inch diameter.

Use the equation above to answer the following questions. Round to the nearest hundredth.

1. Solve for t.

2. **a.** Find the time it takes for the tub to go from being full to half full.

   b. Find the time it takes for the tub to go from being half full to empty.

3. Find the time it takes for the tub to go from being full to empty.

4. Use a graphing calculator to graph the height of the water versus time. (The y-axis is the height (in inches), and the x-axis is the time (in seconds) in intervals of 30 seconds.)

5. Based on your results from Exercises 1–4, what general statement can you make about the speed at which the water drains? Explain your answer.

   Bonus: Is it possible to *rationalize* the denominator after solving for t?

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1.5 Puzzle Time

What Happened To The Shark Who Swallowed A Bunch Of Keys?

Write the letter of each answer in the box containing the exercise number.

Solve the literal equation for *y*.

1. $y + 5x = 17$
2. $4y - 36x = 28$
3. $8x - 11 = 13 + 8y$
4. $6 + \frac{1}{3}y = 10 + 12x$

Solve the literal equation for *x*.

5. $y = 9x - 2x$
6. $d = 5x + 10xf$
7. $rx - sx = p$
8. $3j = 4kx + 7mx + n$

Solve the equation for the indicated variable.

9. Volume of a cone: $V = \frac{1}{3}\pi r^2 h$; Solve for h.
10. Perimeter of a rectangle: $P = 2\ell + 2w$; Solve for w.
11. Area of a rectangle: $A = \ell w$; Solve for ℓ.
12. The surface area of a right circular cylinder is given by the formula $S = 2\pi rh + 2\pi r^2$. Solve the equation for h.

Answers

O. $y = x - 3$

W. $x = \frac{3j - n}{4k + 7m}$

T. $x = \frac{d}{5 + 10f}$

O. $y = 9x + 7$

E. $y = -5x + 17$

G. $h = \frac{3V}{\pi r^2}$

K. $y = 36x + 12$

H. $x = \frac{p}{r - s}$

L. $\ell = \frac{A}{w}$

A. $x = \frac{1}{7}y$

C. $w = \frac{P - 2\ell}{2}$

J. $h = \frac{S - 2\pi r^2}{2\pi r}$

7	1		9	3	6		11	2	10	4	12	5	8

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Chapter 1 Cumulative Review

In Exercises 1–8, add or subtract.

1. $4 - 6$

2. $0 + (-17)$

3. $-5 + 7$

4. $10 + (-2)$

5. $4 - (-13)$

6. $-11 - (-23)$

7. $17 + 8$

8. $-19 + 21$

In Exercises 9–24, multiply or divide.

9. $-4(5)$

10. $-5 \bullet (-6)$

11. $3 \bullet (-1)$

12. $7(-2)$

13. $19 \bullet 2$

14. $-7(-6)$

15. $9 \bullet (-8)$

16. $4(2)$

17. $-20 \div 5$

18. $48 \div (-3)$

19. $-38 \div (-2)$

20. $8 \div (-2)$

21. $-18 \div (-3)$

22. $32 \div 8$

23. $-48 \div 6$

24. $63 \div (-9)$

In Exercises 25–28, solve the problem and specify the units of measure.

25. You mow your neighbor's lawn in 5 hours and earn \$45. What is your hourly wage?

26. How many packages of diapers can you buy with \$36 when one package costs \$9?

27. At a gas station you buy 15 gallons of gas. The total cost is \$60. What is the cost per gallon?

28. On Saturday, you run 4 miles more than your friend. Your friend ran 3 miles. How many miles did you run?

29. A flower bed is in the shape of a rectangular prism. Its dimensions are 3 feet wide by 16 feet long by 6 inches deep.

a. How many cubic feet of topsoil do you need to fill the flower bed?

b. You can spread topsoil at a rate of 4 cubic feet per minute. How long will it take you to spread all the topsoil?

In Exercises 30–37, solve the equation, justify each step, and check your answer.

30. $x + 5 = 7$

31. $y - 4 = 2$

32. $x + (-3) = 5$

33. $10 - m = -3$

34. $4g = 36$

35. $3b = 39$

36. $c + 7 = 14$

37. $\frac{y}{2} = 15$

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Name _____ Date _____

Chapter 1 Cumulative Review (continued)

In Exercises 38–43, solve the equation. Check your solution.

38. $\frac{3}{4} + x = \frac{5}{4}$

39. $-\frac{2}{3}w = 14$

40. $w \div (-4) = -0.9$

41. $3.4 = r - 1.2$

42. $3\pi + a = 8\pi$

43. $7\pi x = -105\pi$

In Exercises 44–47, write and solve an equation to answer the question.

44. You have \$437 in a savings account. After a deposit, the balance is \$1087. What was the amount of the deposit?

45. At a restaurant, you and four friends divide the bill evenly. Each person pays \$7.35. How much is the total bill?

46. How many packages of mechanical pencils can you buy with \$45.30 when one package costs \$7.55?

47. You are selling candy bars for a fundraiser at school. You sell $\frac{1}{5}$ of the candy bars on the first day. You have 40 candy bars left. How many candy bars did you start with?

In Exercises 48–59, solve the equation. Check your solution.

48. $18x - 14 = -14$

49. $3g + 5 = 20$

50. $13 = 7 - w$

51. $3 = \frac{c}{5} + 2$

52. $\frac{x}{7} - 10 = -8$

53. $\frac{z + 2}{3} = 6$

54. $\frac{t - 4}{7} = 2$

55. $7w + 6w = 26$

56. $24 = 11u - 5u$

57. $0 = \frac{y}{4} - 3$

58. $8x - 3 - 2x = 21$

59. $7q + 5q - 17 = -5$

In Exercises 60–62, write and solve an equation to answer the question.

60. A mechanic charges \$43 per hour for labor and \$217 for parts. The total bill is \$432. How many hours did the mechanic work?

61. There are 158 students on a field trip. Five students traveled in cars and the rest traveled in three full buses. How many students traveled in one bus?

62. A basketball team sells boxes of candy bars to raise money for new basketball hoops. The teachers buy six boxes to eat in the teachers' lounge. The students sell an additional 540 candy bars. The team sells a total of 810 candy bars. How many candy bars are in each box?

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Chapter 1

Cumulative Review (continued)

In Exercises 63–78, solve the equation. Check your solution.

63. $24 - 8x = 4x$

64. $34 - 6t = 11t$

65. $7h - 12 = 3h + 24$

66. $8r + 30 = -2 - 8r$

67. $-2w + 7 = 9w - 4$

68. $5b - 14 = 8b + 4$

69. $h - 1 = 5h + 3h - 8$

70. $8k - 14 - 3k = 7k + 4 + k$

71. $60 = 4(-6r - 3)$

72. $3(x + 2) = 2(x - 9)$

73. $2(4g - 1) = 3(g + 6)$

74. $\frac{1}{3}(6t + 12) = -3(2t - 4)$

75. $-3(2y - 5) = -7(y - 2)$

76. $\frac{4}{5}(10y - 10) = \frac{2}{7}(7y + 14)$

77. $2(3x + 1) = 3(x + 6) - x$

78. $x + 3(x + 1) = -3(x - 8)$

79. You and your friend start running toward each other. The equation $47m = 200 - 53m$ represents the number of m minutes until you and your friend meet. When will you meet?

80. Gym A charges a \$50 membership fee and \$20 per month. Gym B charges a \$10 membership fee and \$30 per month. After how many months is the total cost the same at both gyms?

In Exercises 81–86, solve the equation. Determine whether the equation has *one solution, no solution,* or *infinitely many solutions.*

81. $y + 3 - y = 9$

82. $\frac{3}{4}x + \frac{1}{4}x = x + 1$

83. $8x - 4 = 7x - 1$

84. $2(3t + 3) = 3(2t + 2)$

85. $7h + 8 = 26 - 2h$

86. $3(5 + a) = \frac{1}{4}(28 + 12a)$

In Exercises 87–94, simplify the expression.

87. $|-4|$

88. $-|10|$

89. $|5| - |-5|$

90. $|-7| + |7|$

91. $-|-3 \cdot (-4)|$

92. $|-0.2 \cdot 5|$

93. $\left|\frac{36}{-9}\right|$

94. $\left|-\frac{-15}{3}\right|$

In Exercises 95–102, solve the equation. Graph the solution(s), if possible.

95. $|r| = 3$

96. $|d| = -7$

97. $|h| = -19$

98. $|b| = 21$

99. $|x + 2| = 4$

100. $|w - 5| = 5$

101. $|-2r| = 10$

102. $\left|\frac{y}{4}\right| = 8$

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Chapter 1 Cumulative Review (continued)

In Exercises 103–110, solve the equation. Graph the solution(s), if possible.

103. $|2x - 4| = 10$

104. $|y + 7| - 2 = -5$

105. $-5|6 - 3n| = -30$

106. $-3|9x - 7| = 2$

107. $|2n - 8| - 3 = -3$

108. $4|7u - 10| = -8$

109. $-10|3v + 6| + 5 = -85$

110. $5 = 3\left|\frac{1}{2}y - 4\right| - 7$

111. A thermometer comes with a guarantee that the displayed temperature differs from the actual temperature by no more than 1.5 degrees Fahrenheit. Write and solve an equation to find the minimum and maximum actual temperatures when the thermometer displays 54.5 degrees Fahrenheit.

112. You are filling your tire with air. The recommended pressure is 41 pounds per square inch. You read your owner's manual and find out that you can be within 2 pounds per square inch of the recommended amount. Write and solve an equation to find the minimum and maximum pressure for your tire.

113. A machine fills bags with 16 ounces of sugar. Each bag must be filled to within 0.3 ounce of the required amount. Write and solve an equation to find the minimum and maximum weight that the bags can be filled.

In Exercises 114–116, solve the equation. Check your solutions.

114. $|x + 2| = 3x$

115. $|6x - 16| = 2x$

116. $|z - 4| = |z + 6|$

In Exercises 117–122, solve the literal equation for y.

117. $y - 2x = 14$

118. $6x + y = 2$

119. $4x - 2y = 10$

120. $-12x - 3y = 15$

121. $14 - 7y = 21$

122. $4 - \frac{2}{3}y = 10 - 6x$

In Exercises 123–125, solve the literal equation for x.

123. $y = 3x + 6x$

124. $m = 9x - x$

125. $ux + rx = w$

126. The total cost C (in dollars) of playing an online game is given by the literal equation $C = 30x + 50$, where x is the number of months you play the game. Solve the equation for x. How many months do you play the game when you spend \$170? \$260?

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